AMENDMENTS

This listing of claims will replace all prior versions, and listings, of claims in the application.

1-14. **(Canceled)**

15. **(Currently Amended)** ~~The method of claim 13, wherein (iii) comprises:~~ A method for determining a path of a pen tip within a document, the method comprising:

(A) decoding extracted bits associated with a captured image to determine location coordinates of the captured image, by:

(A)(i) obtaining the extracted bits that are associated with a captured array;

(A)(ii) processing the extracted bits to determine whether the extracted bits contain at least one error bit and to determine the location coordinates if no error bits are detected; and

(A)(iii) if the at least one error bit is detected, further processing the extracted bits to determine the location coordinates from a portion of the extracted bits, by:

(A)(iii)(1) if an error bit is detected, selecting a different subset from the extracted bits, wherein at least one bit of the different subset is not one of previously correctly decoded bits;

(A)(iii)(2) decoding associated bits of the different subset;

(A)(iii)(3) in response to (2), determining whether another decoding iteration shall be performed;

(A)(iii)(4) if another decoding iteration shall be performed, selecting another subset from the extracted bits wherein at least one bit of the other subset is selected from a set of wrongly decoded bits of each previous iteration and repeating (2); and

(A)(iii)(5) if another decoding iteration shall not be performed, determining the location coordinates of the captured array, wherein the location coordinates are consistent with a local constraint;

(B) in response to (A), if the location coordinates of the captured image cannot be determined by decoding, matching the captured image with image information of the document; and

(C) mapping the path of the pen tip from the location coordinates of the captured image to the location coordinates of the tip of the pen.

16-17. **(Canceled)**

18. **(Currently Amended)** ~~The method of claim 17, wherein (ii) further comprises:~~ A method for determining a path of a pen tip within a document, the method comprising:

(A) decoding extracted bits associated with a captured image to determine location coordinates of the captured image;

(B) in response to (A), if the location coordinates of the captured image cannot be determined by decoding, matching the captured image with image information of the document, by:

(B)(i) matching the captured image with an area of an image of the document, wherein the area is estimated by analyzing the image of the document or a corresponding location of a neighbor image frame, and wherein the corresponding location is determined by m-array decoding or global localization;

(B)(ii) in response to (i), if the location coordinates cannot be determined, warping the captured image, by:

(B)(ii)(1) scaling and rotating a captured image by applying an affine transform obtained from maze pattern analysis;

(B)(ii)(2) aligning the captured maze pattern to a select point of a search region; and

(B)(ii)(3) matching the warped frame with a document image, wherein the warped frame corresponds to a largest cross-correlation value; and

(B)(iii) matching the captured image with an area of the document, wherein an x-y position cannot be uniquely determined by m-array decoding; and

(C) mapping the path of the pen tip from the location coordinates of the captured image to the location coordinates of the tip of the pen.

19-20. **(Canceled)**

21. **(Currently Amended)** ~~The method of claim 20, wherein (D) further comprises:~~ A method for determining a path of a pen tip within a document, the method comprising:

(A) decoding extracted bits associated with a captured image to determine location coordinates of the captured image;

(B) in response to (A), if the location coordinates of the captured image cannot be determined by decoding, matching the captured image with image information of the document, by:

(B)(i) matching the captured image with an area of an image of the document, wherein the area is estimated by analyzing the image of the document or a corresponding location of a neighbor image frame, and wherein the corresponding location is determined by m-array decoding or global localization;

(B)(ii) in response to (i), if the location coordinates cannot be determined, warping the captured image; and

(B)(iii) matching the captured image with an area of the document, wherein an x-y position cannot be uniquely determined by m-array decoding;

(C) mapping the path of the pen tip from the location coordinates of the captured image to the location coordinates of the tip of the pen; and

(D) determining the area of the document, wherein the area is occluded by content of the document, and wherein the document is watermarked, by:

(D)(i) obtaining a document image, wherein the document image is watermarked;

(D)(ii) determining whether a neighboring window of a pixel only contains maze pattern cells, wherein the document image is represented by a plurality of sub-windows; and

(D)(iii) if the sub-window does not contain only the maze pattern, differentiating a measure of visible maze pattern cells.

22. **(Original)** The method of claim 21, wherein (iii) comprises:

(1) partitioning the document image into a plurality of blocks having substantially a same size as maze pattern cells;

(2) if corresponding small blocks are occluded by document content, counting a number of completely visible blocks in a neighboring window with a pixel as the center of the window; and

(3) labeling the pixel with an indicator that is indicative of the number of visible blocks.

23-33. **(Canceled)**

34. **(New)** The method of claim 15, wherein the image information is selected from watermarked document image information or image information of a neighboring area of a decoded position corresponding to the captured image.

35. **(New)** The method of claim 15, further comprising:

(D) analyzing a maze pattern to extract bits from the captured image, wherein the maze pattern corresponds to an m-array.

36. **(New)** The method of claim 35, further comprising:

(E) segmenting the maze pattern from an obstruction component of the captured image, wherein the obstruction component occludes the maze pattern.

37. **(New)** The method of claim 36, wherein (E) comprises:

       (E)(i) normalizing the captured image to compensate for non-uniform illumination.

38. **(New)** The method of claim 15, wherein (B) comprises:

       (B)(i) matching the captured image with an area of an image of the document, wherein the area is estimated by analyzing the image of the document or a corresponding location of a neighbor image frame, and wherein the corresponding location is determined by m-array decoding or global localization.

39. **(New)** The method of claim 38 wherein (B) further comprises:

       (B)(ii) in response to (i), if the location coordinates cannot be determined, warping the captured image; and

       (B)(iii) matching the captured image with an area of the document, wherein an x-y position cannot be uniquely determined by m-array decoding.

40. **(New)** The method of claim 39, wherein (B) further comprises:

       (B)(iv) in response to (iii), repeating (i).

41. **(New)** The method of claim 39, further comprising:

       (D) determining the area of the document, wherein the area is occluded by content of the document, and wherein the document is watermarked.

42. **(New)** The method of claim 15, further comprising:

       (D) calibrating the pen tip to obtain a calibration parameter, wherein (C) comprises using the calibration parameter and a perspective transform obtained from local localization.

43. **(New)** The method of claim 42, wherein (D) comprises:

       (D)(i) fixing the pen tip at a contact point on the document;

(D)(ii) changing a position of a pen camera center; and

(D)(iii) mapping the position of the pen camera center to the contact point.

44. **(New)** The method of claim 42, wherein the calibration parameter is indicative of a virtual pen tip position.

45. **(New)** The method of claim 35, wherein (D) comprises:

(D)(i) calculating a pattern parameter, the pattern parameter characterizing grid lines of the maze pattern.

46. **(New)** The method of claim 39, wherein (ii) comprises:

(B)(ii)(1) scaling and rotating a captured image by applying an affine transform obtained from maze pattern analysis; and

(B)(ii)(2) aligning the captured maze pattern to a select point of a search region.

47. **(New)** The method of claim 41, wherein (D) comprises:

(D)(i) obtaining a document image, wherein the document image is watermarked.

48. **(New)** The method of claim 18, wherein the image information is selected from watermarked document image information or image information of a neighboring area of a decoded position corresponding to the captured image.

49. **(New)** The method of claim 18, further comprising:

(D) analyzing a maze pattern to extract bits from the captured image, wherein the maze pattern corresponds to an m-array.

50. **(New)** The method of claim 49, further comprising:

(E) segmenting the maze pattern from an obstruction component of the captured image, wherein the obstruction component occludes the maze pattern.

51. **(New)** The method of claim 50, wherein (E) comprises:

(E)(i) normalizing the captured image to compensate for non-uniform illumination.

52. **(New)** The method of claim 18, further comprising:

(D) calibrating the pen tip to obtain a calibration parameter, wherein (C) comprises using the calibration parameter and a perspective transform obtained from local localization.

53. **(New)** The method of claim 52, wherein (D) comprises:

(D)(i) fixing the pen tip at a contact point on the document;

(D)(ii) changing a position of a pen camera center; and

(D)(iii) mapping the position of the pen camera center to the contact point.

54. **(New)** The method of claim 52, wherein the calibration parameter is indicative of a virtual pen tip position.

55. **(New)** The method of claim 18, wherein (A) comprises:

(A)(i) obtaining the extracted bits that are associated with a captured array;

(A)(ii) processing the extracted bits to determine whether the extracted bits contain at least one error bit and to determine the location coordinates if no error bits are detected; and

(A)(iii) if the at least one error bit is detected, further processing the extracted bits to determine the location coordinates from a portion of the extracted bits,

wherein the location coordinates are consistent with a local constraint.

56. **(New)** The method of claim 55, wherein (ii) comprises:

(A)(ii)(1) selecting a first subset from the extracted bits;

(A)(ii)(2) decoding the first subset; and

(A)(ii)(3) in response to (A)(ii)(2), if no error bits are detected, determining the location coordinates of the captured array.

57. **(New)** The method of claim 49, wherein (D) comprises:

(D)(i) calculating a pattern parameter, the pattern parameter characterizing grid lines of the maze pattern.

58. **(New)** The method of claim 18, wherein (C) comprises:

(C)(i) calculating pen tip location coordinates from virtual pen tip coordinates utilizing a perspective transform.

59. **(New)** The method of claim 21, wherein the image information is selected from watermarked document image information or image information of a neighboring area of a decoded position corresponding to the captured image.

60. **(New)** The method of claim 21, wherein (A) comprises:

(A)(i) obtaining the extracted bits that are associated with a captured array;

(A)(ii) processing the extracted bits to determine whether the extracted bits contain at least one error bit and to determine the location coordinates if no error bits are detected; and

(A)(iii) if the at least one error bit is detected, further processing the extracted bits to determine the location coordinates from a portion of the extracted bits,

wherein the location coordinates are consistent with a local constraint.

61. **(New)** The method of claim 60, wherein (ii) comprises:

(A)(ii)(1) selecting a first subset from the extracted bits;

(A)(ii)(2) decoding the first subset; and

(A)(ii)(3) in response to (2), if no error bits are detected, determining the location coordinates of the captured array.

62. **(New)** The method of claim 21, wherein (C) comprises:

(C)(i) calculating pen tip location coordinates from virtual pen tip coordinates utilizing a perspective transform.